September 2020

MIDSOLES DESIGN TO ALLOCATE SENSORS

HP INC

Midsole Design to Allocate Sensors

Footwear industry is using more and more 3D printing technology to develop and manufacture their products and prototypes. According to the "3D-Printed Footwear 2019-2029, an Analysis of the Market Potential of 3D Printing in the Footwear Industry" study specifies that the overall demand of AM materials in Footwear Industry is expected to reach 3.7 thousand metric tons by 2029. Accordingly, adding new functionalities in the midsole can be of high importance for the future market. This technology allows midsoles not only to be more agile and flexible during the initial design & testing phases but also allows them to iterate faster with a faster time to market meeting the customer expectations with a better product.

Another growing trend in the market is the data digitalization and the use of data to define novel products and to offer new services to the customers. Regarding this point, much effort is focused on how to gather this data and what it can be done with it. This disclosure explains an improved midsole design in order to incorporate sensors in it without impacting on its performance. This design will enable a hidden sensor and allow to interchange it whenever necessary.

The problem that this disclosure aims to solve is to design a space to locate different type of sensors that enable data gathering for future services or products. This space can be optimized depending on the sensor type and specifications. Additionally, the sensor may be placed at the lowest feet pressure area such that the sensor does not impact on midsole performance. The cover design will allow an easy opening (adding a feature to be opened by the finger) and a proper closure (the cover will have clips distributed) not to damage the user when walking/running on the midsole.

To gather information while the user is walking, some studies placed the sensors directly on the foot. For example, the paper "The sweating foot: Local differences in sweat secretion during exercise-induced hyperthermia" measured the sweat on different areas of the foot.

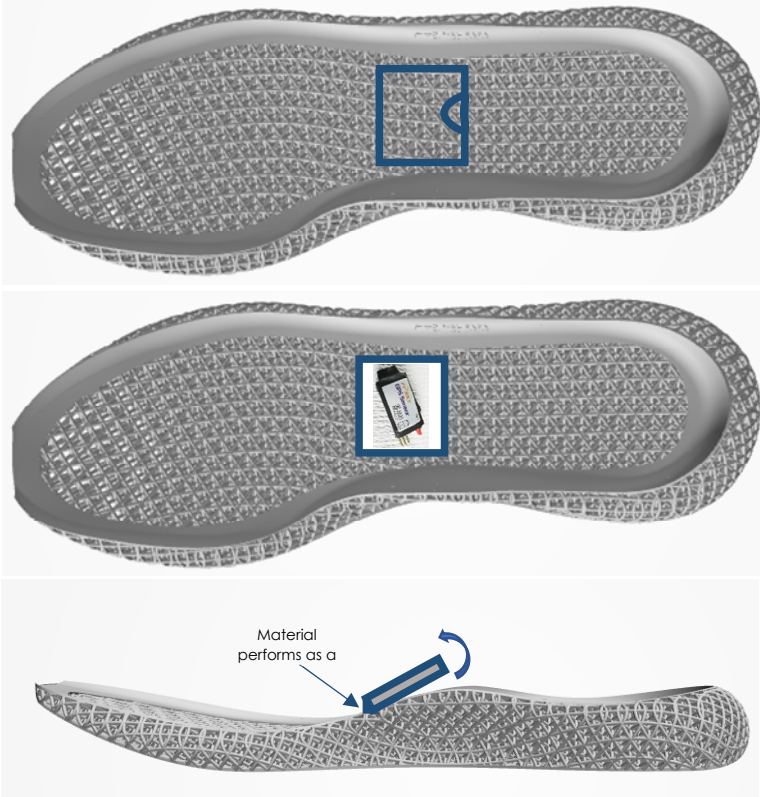
Other ways to gather information during an activity is by using external devices, which integrate different types of sensors. For example, by using a GPS device (position and height data) integrated, for example, within a watch. Accordingly, the athlete needs an external accessory, which is in some cases uncomfortable, in addition to a more expensive solution (than if we can integrate the functionality in the midsole directly).

The use of 3D printing technology enables to add new functionalities within midsoles while keeping the same performance and without incrementing costs.

When looking at the feet pressure patterns, it can be identified that the central part of the midsole is the area with the lowest contact (see data from https://www.pinnashoes.com/en/foot-scan/). That means, it is a good place to modify the internal lattices of the midsole to leave a space to locate sensors.

Manufacturing the midsoles with flexible polymeric materials, such as TPU/TPA, i enables a cover linked to the midsole at one end where the material may perform as a spring. The remaining walls may be designed to have a gap within midsole to be able to open it.

This is a feature in which the user may introduce his finger to be able to open it easily. Additionally, different clips located equidistant will be enabled to ensure that the cover is closed properly when the user is using the midsole.



The central part of the rectangle will be defined in the midsole in the area with the lowest pressure. Then, the width and length dimensions that define the sensor space will be parametric variables depending on the sensor characteristics and the users' needs; for example, by knowing how many sensors the customer wants to use.

If the user does not need to change the sensor, a textile cover on the midsole may be added to hide this feature.

The proposed solution has the following advantages:

- To integrate a new functionality in the midsoles design by allowing the location of sensors therein.
- To enable gathering of data for future novel products identification and offer a wider range of services to customers.
- The addition of this functionality is neither compromising athletic performance nor increasing part cost.
- The space left for keeping sensors may be customized depending on the sensor's characteristics and customer needs.

Disclosed by Davinia Font Calafell and Alberto Maria Canals, HP Inc